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is a dilute form of yellow corresponding in nature to the dilute forms of black and brown. A very simple and direct test of this matter is obtained by breeding "cream" animals together.

Cream-colored, like all other shades of yellow mice, are regularly heterozygous, producing black or brown pigmented young as well as those which are yellow, the yellows being to the non-yellows approximately as two to one.² Now if the "cream" condition of yellow is produced by the same factor as the dilute condition of black and brown, the "creams" bred together should produce non-yellow young all of which are *dilute*, since, as stated, dilution is recessive in nature.

Such, however, is not the case. Cream animals mated together produce only cream or light-colored yellow offspring, but the black or brown pigmented young which they produce are commonly of full intensity. Accordingly, it follows that the "cream" modification of yellow is different in nature from the dilute modification of black and must be produced by a different factor.

This fact being established, search was begun for a type of yellow which when bred by itself would produce yellows and dilute forms of black and brown. Such yellows should, when obtained, be distinguishable from the intense yellow as well as the "cream" type, and should show on microscopic examination of the hair a condition of pigment reduction equal in amount to that seen in the dilute black or dilute brown forms.

Such yellows have been obtained. They may be deep red, light cream, or any of the intermediate gradations, but they possess an extremely characteristic washed-out dull appearance, which serves to distinguish them clearly from intense forms, even though these be extremely light colored.

Since this form of yellow occurs in all the gradations from "red" to "cream," it is apparent that it represents an independent form of pigment reduction; and since, unlike the "cream" reduction, it is transferable to black

or brown, it is safe to class it as the *dilute form of yellow*.

The fact that black and brown pigment is present in agouti animals in a presumably constant degree of intensity and that the yellow pigment may independently vary in these animals from cream to deep red, may possibly serve to explain the marked variations seen in the type known as intense black agouti (golden agouti).

A table showing the result of crossing "creams" (light yellow) *inter se* follows.

TABLE I

Parents, "cream" × "cream";
Offspring, "cream" 31, black 10, brown 14.
(light yellow) (intense) (intense)

From Table I. it will be seen that non-yellow young of a dilute character are not produced by mating cream-colored animals *inter se*. On the other hand, such young have been produced by dilute yellows crossed *inter se*, as shown by Table II.

TABLE II

Parents, dilute yellow × dilute yellow;
Offspring, dilute yellow 95, dilute non-yellow 52.

Further, when dilute yellows are mated with dilute non-yellows the non-yellow offspring are all dilute (see Table III.).

TABLE III

Parents, dilute yellow × dilute non-yellow;
Offspring, dilute yellow 38, dilute non-yellow 37.

In the foregoing account dark-eyed yellows are alone used in computing the numerical results. Experiments with pink-eyed yellow forms have been conducted, but the data have not yet been tabulated.

C. C. LITTLE

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DIMORPHISM OF THE GAMETES OF *CENOTHERA*¹

PROFESSOR DE VRIES² has brought to light a

¹ Read before the Botanical Society of Washington, May 2, 1911.

² "Ueber doppeltreziproke Bastarde von *Cenothera biennis* L. und *O. muricata* L.," in *Biologisches Centralblatt*, 31: 97-104, No. 4, February 15, 1911.

² See SCIENCE, N. S., Vol. XXXII., No. 833, pp. 868-870.

remarkable form of dimorphism of the gametes of several species of evening primrose. If reciprocal hybrids are made between, say, *Oenothera biennis* and *O. muricata*, the resulting hybrids are very unlike and strongly patrocline, in both cases presenting only slight traces of any influence by the female parent. Detailed investigations now under way by Professor de Vries show that the ovules and pollen grains carry quite different hereditary tendencies. The common *Oenothera biennis* represents the form inherited through the pollen, the characters carried by the ovules being recessive. If *O. biennis* is crossed with pollen of another species over which it is dominant, the result is to bring into expression the form inherited through the ovules, which de Vries calls the *conica* form. This form is obtained if *Oenothera biennis* is crossed with pollen of *O. muricata*, *O. Hookeri*, *O. strigosa*, etc. Similarly, if *Oenothera muricata* is pollinated with *O. biennis* (Chicago form), *O. Hookeri* and *O. strigosa*, it yields what de Vries calls the *frigida* form which represents the form of *O. muricata* inherited through the ovules.

The ordinary form of *O. biennis* represents what de Vries calls the pollen picture of this species, the pollen form (*biennis*) being dominant over the ovule form (*conica*). The same is true of *O. muricata*, the ovule form (*frigida*) being recessive to the pollen form (*muricata*).

This property of producing gametes having diverse hereditary qualities is termed by Professor de Vries "*Heterogamie*," but as this term is already used in many different senses it seems best to propose instead a new term, *allogametism*, after the analogy of such words as *allotropism*.

The pollen grains and ovules of *Oenothera biennis* and *O. muricata* would constitute *allogametes*.

If B represents *Oenothera biennis*, M, *Oenothera muricata*, H, *Oenothera Hookeri*, and L, *Oenothera Lamarckiana*, the second term being the male parent in each case, some of the remarkable results of *allogametism* are as follows:

Hybrid BM = *conica* (ovule picture of *O. biennis*).

Hybrid MB = *biennis* (pollen picture of *O. biennis*).

Hybrid MH = *frigida* (ovule picture of *O. muricata*).

Hybrid LM = *muricata* (pollen picture of *O. muricata*).

In such *allogametic* species of *Oenothera* the diversity of the gametes of the two sexes does not become apparent unless reciprocal hybrids are made with another species, whereupon very different results are obtained, depending upon which species is used as the female parent.

In case the reciprocal hybrids of the same two parents are crossed, what de Vries calls double reciprocal hybrids result, thus

$$\begin{aligned} \text{BM} \times \text{MB} &= \text{B}, \\ \text{MB} \times \text{BM} &= \text{M}. \end{aligned}$$

In such cases the "peripheral"³ grand parent shows complete dominance, while the "central"³ grand parent is eliminated, thus:

$$\begin{aligned} \text{B(M)} \times (\text{M})\text{B} &= \text{B}, \\ \text{M(B)} \times (\text{B})\text{M} &= \text{M}. \end{aligned}$$

If a patrocline hybrid is crossed with pollen of the paternal species, what de Vries calls *iterative* hybrids result, exactly like the first hybrid and very like the paternal species, thus:

$$\begin{aligned} \text{MB} \times \text{B} &= \text{MB} = \text{B}, \\ \text{B} \times \text{BM} &= \text{BM} = \text{M}. \end{aligned}$$

The central term in the formula is eliminated in this case, $\text{M(B)} \times \text{B} = \text{MB} = \text{B}$.

If a patrocline hybrid be crossed with pollen of the mother species, what de Vries calls *sesqui-reciprocal* hybrids result in which the grandpaternal species is eliminated, thus:

$$\begin{aligned} \text{MB} \times \text{M} &= \text{M}, \\ \text{BM} \times \text{B} &= \text{B}. \end{aligned}$$

The central term in the formula is again eliminated, $\text{M(B)} \times \text{M} = \text{M}$.

Not all the characters of the species were found to be transmitted *allogametically*. In

³ So called from the position in the above formulæ.

O. biennis and *O. muricata*, however, the only exception seems to be in the size and form of the petals.

The very interesting discovery was made by J. M. Geerts⁴ that approximately half the ovules and half the pollen grains of the allogametic species of *Oenothera* are abortive. It is suggested that in case of *Oenothera biennis* only those ovules that carry the *conica* form develop, those that should carry the *biennis* form aborting. On the other hand only those pollen grains which carry the *biennis* form mature, those that should carry the *conica* form failing to develop.

WALTER T. SWINGLE

STUDIES IN ARTERIOSCLEROSIS

MUCH has appeared in the literature in recent years upon the etiology and process of development of arteriosclerosis. Many observations have been made upon the human subject and also in experimental animals, of points co-relating certain factors with the production of disease in the arterial tree. In most instances these factors have been carefully studied by competent observers and in many instances the results have been verified by others.

The gathering of facts concerning arteriosclerosis is quite simple—the interpretation of these involves much difficulty. In carrying out any experiment or in offering reasons for a given result, we are constantly reminded of the manifold factors which enter a given experiment or which are naturally present. Often our experiment on animals only induces altered conditions which indirectly bring about the result we are seeking. That the greatest care must be exercised in drawing inferences from animal experimentation is well illustrated in studies upon arteriosclerosis.

Recently Levin and Larkin¹ have published the results of their experiments on dogs, in

which by producing an arterio-venous anastomosis between the external jugular vein and the external carotid artery, they arrive at the sweeping conclusion that “arteriosclerosis can not be artificially induced in a previously healthy blood-vessel by a change in the blood pressure alone.” To *this type* of conclusion we must take exception.

Levin and Larkin, experimenting on ten dogs, joined the external carotid artery to the external jugular vein. In two of these dogs thrombosis occurred close to the line of suture in the vessels. All but two of the remaining eight animals received injections of adrenalin at varying periods. These eight dogs, which form the positive results and from which the above positive statement respecting arteriosclerosis was made, were allowed to live 102, 38, 72, 15, 124 and 58 and 44 days, respectively.

No one, who has studied diverse pathological lesions, will deny that the distribution of various lesions in organs is not uniform in the animal world. Man is particularly subject to lesions of the circulatory system—a condition not so frequent in lower animals. Rabbits and horses occasionally suffer from arterial lesions—more often seen in the older animals and in certain breeds. Dogs and cats rarely develop lesions in the arteries, even under the most trying circumstances.

This varying susceptibility still awaits an explanation, but in the face of our ignorance in the matter, we must assume the greatest care in drawing broad conclusions or in proposing far reaching principles. Negative experimental results for the dog have no positive bearing upon experimental facts observed in other animals.

Much criticism is offered against the use of the rabbit for experiments upon the circulatory system. The comment has been that spontaneous arterial disease occurs in this animal. And yet none of the critics offer any suggestion for the cause of this spontaneous lesion! Properly selected animals and controlled experiments can reduce the error of “spontaneous” disease to almost a vanishing point. The very feature, in the rabbit, of readily reacting in its arterial tree to different

⁴ Geerts, J. M., “Beiträge zur Cytologie und der partiellen Sterilibät von *Oenothera Lamarkiana*,” in *Recueil des travaux botaniques néerlandais*, 5: 93–208, pl. 5–22 (N. 2–4, June, 1909), also published as a separate article.

¹ *Jour. Exper. Med.*, 1911, XIII., p. 24.